ACADEMIC REGULATIONS

Applicable for students admitted into M.Tech. programme from 2011-12

The Jawaharlal Nehru Technological University Anantapur shall confer M.Tech. Post graduate degree to candidates who are admitted to the Master of Technology Programmes and fulfill all the requirements for the award of the degree.

1. ELIGIBILITY FOR ADMISSIONS:

Admission to the above programme shall be made subject to the eligibility, qualifications and specialization prescribed by the competent authority for each programme, from time to time.

Admissions shall be made either on the basis of merit rank obtained by the qualifying candidates at an Entrance Test conducted by the University or on the basis of GATE/PGECET score, subject to reservations or policies framed by the Government of Andhra Pradesh policies from time to time.

2. ADMISSION PROCEDURE:

As per the existing stipulations of AP State Council for Higher Education (APSCHE), Government of Andhra Pradesh, admissions are made into the first year as follows

a) Category-A seats are to be filled by Convenor through PGECET/GATE score.

b) Category-B seats are to be filled by Management as per the norms stipulated by Government of A. P.

3. SPECIALIZATION:

The following specializations are offered at present for the M.Tech. programme.

Sl. No.	**Specialization**
1.	CAD/CAM
2.	Digital Electronics and Communication Systems
3.	Embedded Systems
4.	VLSI System Design
5.	Computer Science and Engineering
6.	Electrical Power Engineering
7.	Electrical Power Systems

and any other specialization as approved by the concerned authorities from time to time.

4. COURSE WORK:

4.1. A Candidate after securing admission must pursue the M.Tech. programme of study for four semesters duration.

4.2. Each semester shall be of 20 weeks duration including all examinations.

4.3. A candidate admitted in to the programme should complete it within a period equal to twice the prescribed duration of the programme from the date of admission.

5. ATTENDANCE

5.1. A candidate shall be deemed to have eligibility to write end semester examinations if he has put in at least 75% of attendance aggregate in all subjects/courses in the semester.

5.2. Condonation of shortage of attendance up to 10% i.e., between 65% and above and less than 75% may be granted by the Institute Academic committee.

5.3. Shortage of attendance below 65% in aggregate shall in no case be condoned.

5.4. Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.

5.5. A stipulated fee shall be payable towards condonation of shortage of attendance to the institute.

5.6. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled for that semester.

5.7. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the current semester, as applicable.

5.8. A student detained due to shortage of attendance, will have to repeat that semester when offered next.

6. CREDIT SYSTEM NORMS:

	Period(s)/week	**Credits**
Theory	01	01
Practical	03	02
Seminar	01	01
Project	-	16

TABLE 1

7. EVALUATION:

7.1 Distribution of marks

S. No	Examination	Marks	Examination and Evaluation	Scheme of Evaluation
1.	Theory	60	Semester-end examination (External evaluation)	The question paper shall be of descriptive type with 8 questions out of which 5 are to be answered in 3 hours duration of the examination.
		40	Mid - Examination of 120 Min. duration (Internal evaluation). 5 descriptive questions out of which 4 are to be answered and evaluated for 30 marks, and the reaming 10 marks are to be allotted for 3-5 assignments (2 marks each) to be submitted by the student. The assignment marks are to be awarded based on the completeness of the assignment, correctness of the assignment and in-time submission, evaluated for 10 marks and average of the total assignment marks are rounded to the next integer.	Two mid-exams 30 marks each are to be conducted. Better one to be considered. **Mid-I:** After first spell of instructions (I-IV Units). **Mid-II:** After second spell of instructions (V - VIII Units).
2	Laboratory	60	Semester-end Lab Examination (External evaluation)	**For laboratory courses: 3** hours duration. One External and One Internal examiners.

S. No	Examination	Marks	Examination and Evaluation		Scheme of Evaluation
		40	30	Day to Day evaluation (Internal evaluation)	Performance in laboratory experiments.
			10	Internal evaluation	Practical Tests (one best out of two tests includes viva-voce)
3	Seminar in each of the semesters. 2 hours /week	100	Internal Evaluation 20 Marks for Report 20 Marks for subject content 40 Marks for presentation 20 Marks for Question and Answers		Continuous evaluation during a semester by the Departmental Committee (DC)
4	Project work	100	60	External evaluation	Semester-end Project Viva-Voce Examination by Committee as detailed under sect. 9.
			40	Internal evaluation	Continuous evaluation by the DC. 20 Marks by Supervisor 20 Marks by D.C. as detailed under sect. 9.5

7.2 A candidate shall be deemed to have secured the minimum academic requirement in a subject/practical if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

7.3 A candidate has to secure a minimum of 50% to be declared successful.

7.4 In case the candidate does not secure the minimum academic requirement in any of the subjects/practical, he has to reappear for the Examination either supplementary or regular in that subject/practical along with the next batch students. A separate supplementary examinations will be conducted for the I semester students at the end of II semester.

7.5 **Revaluation / Recounting:** Students shall be permitted to request for recounting/ revaluation of the end theory examination answer scripts within a stipulated period after payment of prescribed fee. After recounting or revaluation, records are updated with changes if any and the student will be issued a revised memorandum of marks. If there are no changes, the student shall be intimated the same through a letter or a notice.

8. RE-REGISTRATION FOR IMPROVEMENT OF INTERNAL EVALUATION MARKS(for theory subjects only):

8.1 Out of the subjects the candidate has failed in the examination due to internal evaluation marks secured being less than 50%, the candidate shall be given one chance for each theory subject and for a maximum of **Three** theory subjects for improvement of internal evaluation marks.

8.2 The candidate can re-register for the chosen subjects and fulfill the academic requirements. Re-registration shall not be permitted after the commencement of class work for that semester. The candidate can re-register for 1st semester subjects when he is in his 3rd semester and for 2nd semester subjects when he is in his 4th semester else the candidate can re-register after completion of 2 years course work.

8.3 For each subject re-registered, the candidate has to pay a fee equivalent to one third of the semester tuition fee.

8.4 In the event of re-registration, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for those subjects stand cancelled.

9. EVALUATION OF PROJECT WORK:

Every candidate shall be required to submit thesis/dissertation after taking up a topic approved by the Departmental Committee.

9.1 The Departmental Committee (DC) consisting of HOD, Project supervisor and two internal senior experts shall monitor the progress of the project work. A Project Review Committee (PRC) shall be constituted with Principal as Chair Person, Heads of the departments of the M.Tech Programs and Two other senior faculty members, as members of the PRC. PRC will come into action when the DC is not able to resolve the issues.

9.2 Registration of Project work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory, practical and seminar of I & II semesters).

9.3 After satisfying 9.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his

project work to the DC for approval. Only after obtaining the approval of DC, the student can initiate the project work.

9.4 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of DC after 36 weeks from the date of registration at the earliest but not later than one calendar year from the date of registration for the project work. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

9.5 The Internal Evaluation shall be made by the DC, on the basis of two seminars presented by the student on the topic of his project.

9.6 The student must submit status report at least in two different phases during the project work period. These reports must be approved by the DC before submission of the Project Report.

9.7 A candidate shall be allowed to submit the thesis / dissertation only after passing all the prescribed subjects (theory, practical and seminar).

9.8 A candidate has to prepare four copies of the thesis/dissertation certified in the prescribed format by the supervisor and HOD. Out of which three copies shall be submitted in the examination section.

10. CREDIT POINT AVERAGE AND CUMULATIVE CREDIT POINT AVERAGE:

10.1. CREDIT POINT AVERAGE (CPA):

$$\textbf{CPA} = \frac{\sum_i C_i T_i}{10\sum_i C_i}$$

Where C_i= Credits earned for Course i in any semester/year.

T_i= Total marks obtained for course i in any semester/year.

10.2. CUMULATIVE CREDIT POINT AVERAGE (CCPA):

$$\textbf{CCPA} = \frac{\sum_n \sum_i C_{ni} T_{ni}}{10\sum_n \sum_i C_{ni}}$$

Where ***n*** refers to the semester in which such courses were credited.

The CCPA is awarded only when a student earns all the credits prescribed for the programme.

10.3. OVERALL PERFORMANCE:

CCPA	Classification of Final Results
7.0 and above	First Class with Distinction
6.0 and above but below 7.0	First Class
5.0 and above but below 6.0	Second Class

11. TRANSCRIPTS:

After successful completion of the entire programme of study, a transcript containing performance of all the academic years will be issued as a final record. Duplicate transcripts will be issued if required, after payment of requisite fee. Partial transcript will also be issued up to any point of study to a student on request.

12. ELIGIBILITY:

A student shall be eligible for the award of M.Tech Degree if he fulfills all the following conditions:

i. Registered and successfully completed all the components prescribed in the programme of study to which he was admitted.
ii. Successfully acquired all **72 credits** as specified in the curriculum corresponding to the branch of his study within the stipulated time.
iii. No disciplinary action is pending against him.

12. AWARD OF DEGREE:

The Degree will be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Anantapur on the recommendations of the Principal, AITS (Autonomous) based on the eligibility as mentioned in clause 11.

13. WITHHOLDING OF RESULTS:

If the candidate has any dues to the Institute or if any case of in-discipline is pending against him, the result of the candidate shall be withheld and he will not be allowed/promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

14. TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course in earlier regulations and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered. Whereas, he continues to be in the academic regulations he was first admitted.

15. AMENDMENTS OF REGULATIONS:

The Chairman, Academic Council of Annamacharya Institute of Technology and Sciences, Rajampet (Autonomous) reserves the right to revise, amend, or change the Regulations, Scheme of Examinations and/or Syllabi or any other policy relevant to the needs of the society or industrial requirements etc., without prior notice.

16. GENERAL:

Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

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Curriculum for the Programmes under Autonomous Scheme							
Regulation		R 2011					
Department		Department of Electrical And Electronics Engineering					
Programme Code & Name		**P7, M.Tech-Electrical Power Systems**					
Semester I							
Subject Code	**Subject Name**	**Hours/ Week**		**C**	**Maximum marks**		
		L	**P**		**Internal**	**External**	**Total**
1P7211	System Theory	4	0	4	40	60	100
1P6212	Power System Control & Stability	4	0	4	40	60	100
1P6213	EHV AC/DC Transmission	4	0	4	40	60	100
1P6214	Reactive Power Compensation & Management	4	0	4	40	60	100
	Elective-I						
1P6215	Soft Computing Techniques	4	0	4	40	60	100
1P6311	Embedded Systems						
1P6216	Power Quality						
	Elective-II						
1P6312	Microprocessors & Microcontrollers	4	0	4	40	60	100
1P6217	Advanced Power System Analysis						
1P6218	Power System Reliability						
1P7212	SEMINAR-I	0	2	2	100	00	100
1P6219	Machines &Power Systems Lab	0	3	2	40	60	100
		24	5	28	800		

Semester II							
Subject Code	**Subject Name**	**Hours/ Week**		**C**	**Maximum marks**		
		L	**P**		**Internal**	**External**	**Total**
1P6221	Operation & Control Of Power System	4	0	4	40	60	100
1P6222	Flexible AC Transmission System	4	0	4	40	60	100
1P6223	Advanced Power System protection	4	0	4	40	60	100
1P7221	Distributed Generation	4	0	4	40	60	100
	Elective-III						
1P6225	Energy Auditing , Conservation & Management	4	0	4	40	60	100
1P6226	Modern Power Electronics						
1P6227	Power System Dynamics						
	Elective-IV						
1P6228	Electrical Power Distribution & Automation	4	0	4	40	60	100
1P6229	Transients In Power Systems						
1P622A	Restructured Power System						
1P7222	SEMINAR-II	0	2	2	100	00	100
1P622B	Power System Simulation Lab	0	3	2	40	60	100
Total		24	5	28	800		

Semester III and SEMESTER IV					
Subject Code	Subject Name	C	Maximum marks		
			Internal	External	Total
1P7231	PROJECT WORK	16	40	60	100
	TOTAL	16	100		

Note: L - Lectures; P – Practical; C - Credits

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M.Tech (EPS) I Semester

SYSTEM THEORY

UNIT – I : STATE VARIABLE ANALYSIS: Introduction-Concept of State-State equation for Dynamic Systems-Time invariance and linearity-Non-uniqueness of state model-State Diagrams-Physical System and State Assignment.

UNIT – II: SOLUTION OF STATE EQUATION: Existence and uniqueness of solutions to Continuous-time state equations-Solution of Nonlinear and Linear Time Varying State equations-Evaluation of matrix exponential-System modes-Role of Eigen values and Eigen vectors.

UNIT – III: CONTROLLABILITY AND OBSERVABILITY: Controllability and Observability, Stabilizability and Detectability - Test for Continuous time Systems- Time varying and Time invariant case-Output Controllability-Reducibility-System Realizations.

UNIT – IV: STABILITY-I: Introduction-Equilibrium Points-Stability in the sense of Lyapunov - BIBO Stability-Stability of LTI Systems-Equilibrium Stability of Nonlinear Continuous Time Autonomous Systems.

UNIT – V: STABILITY – II: The Direct Method of Lyapunov and the Linear Continuous-Time Autonomous Systems-Finding Lyapunov Functions for Nonlinear Continuous Time Autonomous Systems-Krasovskii and Variable-Gradiant Method.

UNIT - VI: MODAL CONTROL-I: Introduction-Controllable and Observable Companion Forms-SISO and MIMO Systems-The Effect of State Feedback on Controllability and Observability.

UNIT – VII: MODAL CONTROL – II: Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers

UNIT – VIII: OPTIMAL CONTROL: Introduction to optimal control – Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear quadratic regulator.

REFERENCE BOOKS:

1. Modern Control System Theory by M. Gopal – New Age International – 1984
2. Modern Control Engineering by Ogata. K – Prentice Hall – 1997
3. Optimal control-An Introduction by Donald E.Kirk, Dover Publications Newyork-1998
4. Automatic Control Systems by Kuo 7th edition, Prentice Hall Of India.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::RAJAMPET
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M.Tech (EPS) I Semester

POWER SYSTEM CONTROL & STABILITY

UNIT-I: THE ELEMENTARY MATHEMATICAL MODEL: A Classical model of one machine connected to an infinite bus – Classical model of multimachine system –Problems – Effect of the excitation system on Transient stability.

UNIT-II: SYSTEM RESPONSE TO SMALL DISTURBANCES: The unregulated synchronous Machine – Effect of small changes of speed – modes of oscillation of an unregulated Multimachine system – regulated synchronous machine – voltage regulator with one time lag – Governor with one time lag – Problems.

UNIT-III: DYNAMIC STABILITY: Concept of Dynamic stability – state space model of one machine system connected to infinite bus – effect of excitation on Dynamic stability – examination of dynamic stability by Routh's criterion

UNIT-IV: POWER SYSTEM STABILIZERS: Introduction to supplementary stabilizing signals- Block diagram of the linear system- Approximate model of the complete exciter – generator system – Lead compensation – Stability aspect using Eigen value approach

UNIT-V: EXCITATION SYSTEMS: Excitation system response – Non-continuously regulated systems – continuously regulated systems – Excitation system compensation – state space description of the excitation system- simplified linear model – effect of excitation on generator power limits.

UNIT-VI: TYPES OF EXCITATION SYSTEMS: Type-2 system: rotating rectifier system, Type-3 system: Static with terminal potential and current supplies - Type-4 system: non – continuous acting - Block diagram representation – state space modeling equations of these types.

UNIT-VII: INTRODUCTION TO VOLTAGE STABILITY: Voltage stability –voltage collapse, voltage security, physical relation indicating dependence of voltage and reactive power flow, Factors affecting voltage instability and collapse – Previous case of voltage collapse incidences.

UNIT-VIII: VOLTAGE STABILITY ANALYSIS: PV curve-QV curve-Control of voltage instability. Voltage Stability analysis-Static & Dynamic Analysis-The Continuation Power Flow Analysis-Prevention of voltage collapse

REFERENCE BOOKS:

1. P.M.Anderson, A.A.Fouad, "Power System Control and Stability", IOWAStateUniversity Press, Galgotia Publications, Vol-I, 1st Edition.
2. M.A.Pai, Power System Stability – Analysis by the direct method of Lyapunov. North Holland Publishing Company, New York, 1981.
3. K.R. Padiyar, Power System Dynamics (Stability & Control), 2nd Edition, B.S.Publications, 2002.

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M.Tech (EPS) I Semester

EHVAC/DC TRANSMISSION\

UNIT- I: E.H.V.A.C. Transmission line trends and preliminary aspect standard transmission voltages – Estimation at line and ground parameters, Bundle conductor systems inductance and capacitance of E.H.V. lines – positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

UNIT- II: Electrostatic field and voltage gradients – calculations of electrostatic field of AC lines – effect high electrostatic field on biological organisms and human beings surface voltage gradients and maximum gradients of actual transmission lines – voltage gradients on sub conductor .

UNIT -III: Electrostatic induction in unenergised lines – measurements of field and voltage gradients for three phase single and double circuit lines – unenergised lines. Power Frequency Voltage control and over voltages in EHV lines : No load voltage – charging currents at power frequency - voltage control – shunt and series compensation – static VAR compensation.

UNIT -IV: Corona in E.H.V. lines – Corona loss formulae attention of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits.

UNIT- V: H.V.DC TRANSMISSION: General consideration , Power Handling Capabilities of HVDC lines , Basic Conversion principles , static converter configuration.

UNIT -VI: STATIC POWER CONVERTERS: 3 pulse, 6 pulse & 12 pulse converters, converter station and terminal equipment communication process, Rectifier and inverter operation, equivalent circuit for converter-special futures of converter transformers.

UNIT -VII: Harmonics in HVDC systems, harmonicas elimination, AC & DC filter Control of HVDC converter and systems: constant current, constant extinction angle and constant ignition angle control. Individual phase control and equidistant firing angle control, DC power flow control.

UNIT -VIII: Interaction between HVAC & DC systems –voltage interaction, harmonic instability problems and DC power modulation.

REFERENCE BOOKS :

1. Extra High Voltage AC Transmission Engineering – Rokosh Das Begamudre, Wiley EASTERN LTD., NEW DELHI – 1987.
2. EHV Transmission line reference Books – Edison Electric Institution (GEC 1968).
3. E.W.Kimbark: Direct current Transmission, Wiely inter Science- New York.
4. J.Arillaga: H.V.D.C.Tranmission peter peregrilnus ltd., London UK 1983.
5. K.R.Padiyar: High Voltage Direct current Transmission, Wiely Eastern Ltd.
6. E.Uhlman: Power Transmission by Direct Current Springer Verlag, Berrlin.

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M.Tech (EPS) I Semester

REACTIVE POWER COMPENSATION AND MANAGEMENT

UNIT-I: LOAD COMPENSATION: Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

UNIT-II: STEADY – STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM: Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples

UNIT-III: TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation – compensation using synchronous condensers – examples.

UNIT-IV: REACTIVE POWER COORDINATION: Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency – Harmonics, radio frequency and electromagnetic interferences.

UNIT-V: DEMAND SIDE MANAGEMENT: Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

UNIT-VI: DISTRIBUTION SIDE REACTIVE POWER MANAGEMENT: System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks.

UNIT-VII: USER SIDE REACTIVE POWER MANAGEMENT: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations.

UNIT-VIII: REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARC FURNACES: Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace

REFERENCE BOOKS:

1. Reactive power control in Electric power systems by T.J.E.Miller, John Wiley and sons, 1982 (Units I to IV)
2. Reactive power Management by D.M.Tagare, Tata McGraw Hill,2004.(Units V to VIII)

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M.Tech (EPS) I Semester

SOFT COMPUTING TECHNIQUES
(Elective –I)

UNIT-I: INTRODUCTION TO NEURAL NETWORKS: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

UNIT-II: ESSENTIALS OF ARTIFICIAL NEURAL NETWORKS: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN-Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

UNIT-III: FEED FORWARD NEURAL NETWORKS: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

UNIT-IV: SUPERVISED LEARNING NETWORKS: ADALINE, MADALINE, Back Propagation Network, BP Learning Rule, Input Layer Computation, Hidden Layer Computation, output Layer computation, Radial Basis Function.

UNIT-V : CLASSICAL & FUZZY SETS: Introduction to classical sets – properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, Properties, fuzzy relations, cardinalities, membership functions.

UNIT-VI: FUZZY LOGIC SYSTEM COMPONENTS: Fuzzification, Membership Value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT-VII: GENETIC ALGORITHMS: Introduction, Basic operators and Terminologies in GA, Traditional Vs Genetic Algorithm, Encoding, Fitness Function, Reproduction, Crossover, Mutation Operators.

UNIT-VIII: APPLICATIONS TO ELECTRICAL SYSTEMS: ANN Based Short Term Load Forecasting, Load Flow Studies, Fuzzy Logic Based Unit Commitment And Genetic Algorithms Based Economic Dispatch.

TEXT BOOK:

1. Neural Netwroks, Fuzylogic ,Gnenetic algorithms: synthesis and applications by Rajasekharan and Rai- PHI Publication.
2. Introduction to Artificial Neural Systems- JacekM.Zurada, Jaico Publishing House, 1997.

REFERENCE BOOKS:

1. Neural and Fuzzy Systems: Foundation, Architectures and Applications, - N.Yadaiah and S. BapiRaju, Pearson Education
2. Neural Netwroks – James A Freeman and Davis Skapura, Pearson, 2002
3. Neural Netwroks and Fuzzy Logic System by BrokKosko, PHI Publications

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M.Tech (EPS) I Semester

EMBEDDED SYSTEMS
(Elective-I)

UNIT-I: OVERVIEW OF EMBEDDED SYSTEM: Embedded System, types of Embedded System, Requirements of Embedded System, Issues in Embedded software development, Applications.

UNIT-II: PROCESSOR&MEMORY ORGANIZATION: Structural units in a processor, processor selection, Memory devices, Memory selection, Memory Allocation& Map; Interfacing.

UNIT-III: DEVICES& BUSES FOR DEVICE NETWORKS: I/O devices, Timer& Counter devices, Serial Communication, Communication between Devices using different buses.

UNIT-IV: DEVICE DRIVERS AND INTERRUPT SERVICING MECHANISM: Device drivers, Parallel and Serial port device drives in a system , Interrupt servicing Mechanism, context and periods for context switching, Deadline and Interrupt Latency.

UNIT-V: PROGRAM MODELING CONCEPTS: Program elements, Modeling Processes for Software Analysis, Programming Models, Modelling of Multiprocessor Systems.

UNIT-VI: SOFTWARE ENGINEERING PRACTICES
Software algorithm Concepts, design ,implementation, testing, validating, debugging, Software Management and maintenance.

UNIT-VII: HARDWARE AND SOFTWARE CO-DESIGN: Embedded system design and co-design issues in software development , design cycle In development phase for Embedded System, Use of ICE & Software tools for development of ES, Issues in embedded system design.

UNIT-VIII: RTOS: OS Services, I/O sub systems, Real Time and Embedded Systems OS, Interrupt routines in RTOS Environment, RTOS Task Scheduling Models

TEXT BOOKS:

1. Embedded Systems: Architecture, Programming and Design-RajKamal,TMH,2003.
2. Programming for Embedded System: Dream Tech Software Team-John Wiley,2002.

REFERENCES:

1. Embedded Systems & Robots by Subrata Ghoshal, CENGAGE Learning.

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M.Tech (EPS) I Semester

POWER QUALITY
(ELECTIVE-I)

UNIT-I: INTRODUCTION: Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring.

UNIT-II: LONG INTERRUPTIONS: Interruptions – Definition – Difference between failure, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption – Overview of Reliability evaluation to power quality, comparison of observations and reliability evaluation.

UNIT-III: SHORT INTERRUPTIONS: Short interruptions – definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

UNIT-IV: VOLTAGE SAG – CHARACTERIZATION: Voltage sag – definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration. Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-V: PQ CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS: Voltage sag – equipment behaviour of Power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

UNIT-VI: MITIGATION OF INTERRUPTIONS AND VOLTAGE SAGS: Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

UNIT-VII: FUNDAMENTALS OF HARMONICS: Harmonic Distortion – Voltage verses Current distortion – Harmonics verses Transients – Harmonic Indexes – Harmonic Sources from Commercial Loads – Harmonic Sources from industrial Loads – locating harmonic sources – System response characteristics – effects of harmonic distortion – inter harmonics.

UNIT-VIII : POWER QUALITY MONITORING: Monitoring Considerations – Historical Perspective of Power Quality measuring Instruments – Power Quality measurement Equipment – Assessment of Power Quality Measurement Data – Application of Intelligent Systems – Power Quality Monitoring Standards.

References:

1. "Understanding Power Quality Problems" by Math H J Bollen. IEEE Press.
2. Electrical Power Systems Quality'' by Roger C. Dugan, Mark E. Mc.Granaghan, Surya Santoso and H. Wayne Beaty,"Mc. Graw Hill, Second Edition.

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M.Tech (EPS) I Semester

MICROPROCESSORS AND MICROCONTROLLERS
(Elective –I)

UNIT-I: INTEL 8086/8088 Architecture, its register organization, Pin diagram, Minimum and Maximum Mode System and Timings, Machine language instruction formats, Addressing modes, Instruction set, Assembler directives.

UNIT-II: HARDWARE DESCRIPTION: Pin diagram, Minimum and Maximum Mode and Bus Timings, Ready and Wait states and 8086 based micro-computing system

UNIT-III: ALP PROGRAMMING & SPECIAL FEATURES: ALP, programming with an assembler, stack structure, Interrupts, Service subroutines and Interrupt programming and Macros.

UNIT-IV: ADVANCED PROCESSORS: Architectural features of 80186, 286, 386, 486 and Processors and their memory management, Introduction to Pentiumand Pentium Pro Processors their features, RISC Vs CISC Processors.

UNIT-V: BASIC PERIPHERALS & THEIR INTERFACING: Memory Interfacing (DRAM), PPI- Modes of operation of 8255, Programmed I/O, Interrupt Driven I/O interfacing to ADC & DAC, Stepper Motor Interfacing

UNIT-VI: SPECIAL PURPOSE OF PROGRAMMABLE PERIPHERAL DEVICES AND THEIR INTERFACING: Programmable timer- 8253, PIC 8259A,Display controller, Programmable Communication Interface 8251-USART and their interfacing.

UNIT-VII: MICRO CONTROLLERS: Introduction to Intel 8-bit and 16-bit Micro controllers, 8051-Architecture, memory organization, Addressing modes.

UNIT-VIII: HARDWARE DESCRIPTION OF 8051: Instruction formats, Instruction sets, Interrupt structure and interrupt priorities, Port structures and Operation Linear Counter functions, Different modes of operation and programming Examples.

REFERENCE BOOKS:

1. "The Intel Microprocessors", Architecture, Programming and interfacing by Barry b Brey
2. 8086 Micro Processors by Kenrith J Ayala, Thomson Publishers.
3. Microcontrollers by K.J.Ayala - Thomson Publishers.
4. Micro Processors and Interfacing Programming and Hardware by Douglas V. Hall.
5. The 8088 and 8086 Microprocessor- W.A. Triebel&Avtar Singh- PHI, 4th Edition.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::RAJAMPET
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M.Tech (EPS) I Semester

ADVANCED POWER SYSTEM ANALYSIS
(Elective-I)

UNIT-I: INCIDENCE AND NETWORK MATRICES: Algorithm for formation of network matrices, Three phase networks, balanced networks, algorithms for formation for 3-phase bus impedance matrix, modification for changes in network.

UNIT-II: SPARSITY TECHNIQUES: Sparsity, sparsity techniques, optimal ordering, tap changing transformers.

UNIT-III: LOAD FLOW STUDIES: Load Flow - Network modeling – Conditioning of Y Matrix – Load flow-Newton Raphson method- Decoupled – Fast decoupled Load flow -three-phase load flow.

UNIT IV: SHORT CIRCUIT ANALYSIS-1: Fault calculations using sequence networks for different types of faults. Bus impedance matrix (ZBUS) construction using Building Algorithm for lines with mutual coupling; Simple numerical problems.

UNIT V: SHORT CIRCUIT ANALYSIS-2: Computer method for fault analysis using ZBUS and sequence components. Derivation of equations for bus voltages, fault current and line currents, both in sequence and phase domain using Thevenin‟s equivalent and ZBUS matrix for different faults.

UNIT VI: OPTIMAL POWER FLOW: Problem statement; Solution of Optimal Power Flow (OPF) – The gradient method, Newton's method, Linear Sensitivity Analysis; LP methods – With real power variables only – LP method with AC power flow variables and detailed cost functions; Security constrained Optimal Power Flow; Interior point algorithm; Bus Incremental costs.

UNIT VII: NUMERICAL INTEGRATION METHODS: Introduction, Numerical Integration Methods: Euler and Fourth Order Runge-Kutta methods, Algorithm for simulation of SMIB and multi-machine system with classical synchronous machine model; Factors influencing transient stability, Numerical stability and implicit Integration methods.

UNIT VIII: POWER SYSTEM SECURITY: Power System Security, Factors affecting Security, State Transition Diagram, Contingency Analysis Using Network Sensitivity Method and AC Power Flow Method, Correcting the Generation Dispatch Using Sensitivity Methods, Introduction to State Estimation.

REFERENCE BOOKS:

1. G.W. Stagg & A.H EI-Abaid, 'Computer methods in Power system analysis', McGraw Hill, New York.
2. M. A. Pai, 'Computer Techniques in Power System Analysis', 2nd Edi., TMH-New Delhi.
3. Kusic., 'Computer-Aided Power System Analysis', Prentice Hall of India, New Delhi.
4. John J.Grainger and W.D.Stevenson, 'Power System Analysis', McGraw Hill, New York, 1994.
5. A.J. Wood & W.F. Wollenberg, 'Power Generation, Operation, and Control', 2nd Edn, John Wiley & Sons, New York, 1996.
6. O.I. Elgerd, 'Electric Energy Systems Theory: An Introduction', McGraw Hill, New York, 1982.
7. J. Arrillaga, C.P Arnold &Harker, 'Computer Modeling of Electrical Power Systems', John Wiley & Sons.
8. Enrique Acha et al., 'FACTS: Modeling and Simulation in Power Networks', John Wiley and Sons Ltd., 2004.
9. Kothari and Dhillon, 'Power Systems Optimization', PHI, 2004.

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M.Tech (EPS) I Semester

POWER SYSTEMS RELIABILITY

UNIT – I: BASIC PROBABILITY THEORY: Probability Concept, Elements of probability theory, Random variables *(*Continuous, *Discrete Variables)*, Density function and Distribution functions. Mean, SD, Variance. Probability Distributions: Exponential Distribution, Binomial Distribution, Poisson distribution, Normal Distribution, Weibull Distribution, Log Normal Distribution.

UNIT – II: RELIABILITY FUNCTIONS: Definition of reliability, Component Reliability, Hazard rate, derivation of the Reliability function in terms of the hazard rate, Bath Tub Curve. MTTF, MTTR,MTBF, types of Failures *(early failures, chance failures and wear-out failures).* Reliability Block Diagrams, Series and Parallel configuration. Series-Parallel configuration, High level and low level redundancy

UNIT – III: NETWORK MODELING: Reliability evaluation of Non - Series-Parallel configurations. Bayer's Theorem Cut-set, Basic Cut-set, Tie-set, and Basic Tie set, Minimal Cut-Set, Minimal Tie – set and Decomposition Methods. Deduction of the Minimal Cut sets from the Minimal paths-Stand by redundant Systems-Concept of redundancy, Perfect Switching, Imperfect Switching-Event trees

UNIT – IV: MARKOV MODELING: Introduction – Markov Process & Markov chain - STPM - Time Dependant probability - functions - Evaluating limiting state probabilities-Absorbing states - Markov process – one component repairable model -Two component repairable model - Three component repairable model.

UNIT V: GENERATING SYSTEM RELIABILITY ANALYSIS – I: Generation system model – Capacity outage probability tables – Recursive relation for capacitive model building – Sequential addition method – Unit removal – Evaluation of loss of load and energy indices – Examples.

UNIT VI: GENERATING SYSTEM RELIABILITY ANALYSIS – II: Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units – 2-level daily load representation - Merging generation and load models – Examples.

UNIT VII: TRANSMISSION SYSTEM RELIABILITY ANALYSIS: System and load point reliability indices – Weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

UNIT VIII: DISTRIBUTION SYSTEM RELIABILITY ANALYSIS (RADIAL CONFIGURATION): Basic Techniques – Radial networks – Evaluation of Basic reliability indices, performance indices - Load point and system reliability indices – Customer oriented, loss and energy oriented indices – Examples.

REFERENCE BOOKS:

1. Reliability Evaluation of Power Systems, Roy Billiton and Ronald N. Allan Plenum Press, New York and London, 2nd Edition, 1996.

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M.Tech (EPS) I Semester

MACHINES &POWER SYSTEMS LAB

1. Characteristics of IDMT Over Current Relay (Electromagnetic Type).
2. Characteristics of Negative Phase Sequence relay (Static Type).
3. Characteristics of Percentage biased differential Relay (static type).
4. Characteristics of Over Voltage Relay (Electromagnetic Type).
5. Characteristics of over voltage/under voltage relay (Micro processor Based Type).
6. Characteristics of Percentage Biased Differential Relay(Electromagnetic Type).
7. Equivalent Circuit of three winding transformer.
8. Scott Connection..
9. Fault Analysis – I
   (i) LG Fault
   (ii) LL Fault
10. Power Angle Characteristics of Salient pole Synchronous machine.
11. Determination of Sub transient Reactance of Salient pole Synchronous Machine.
12. Separation of No-Load Losses of Three Phase Squirrel cage Induction motor.

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M.Tech (EPS) II Semester

OPERATION AND CONTROL OF POWER SYSTEM

UNIT-I: Economic operation- Load forecasting - Unit commitment – Economic dispatch problem of thermal units – Gradient method- Newton's method –Base point and participation factor method.

UNIT-II: **UNIT COMMITMENT AND SOLUTION METHODS:** Optimal Unit Commitment, Constraints in unit commitment, Spinning reserve, Thermal Unit Constraints, Other constraints, Hydro constraints, Must Run, Fuel constraints, Unit commitment Solution methods : Priority-List methods, Dynamic Programming solution. Backward DP Approach, Forward DP Approach, Restricted Search Ranges, Strategies- Reliability considerations

UNIT-III: HYDROTHERMAL CO-ORDINATION: Short-term hydrothermal scheduling problem - gradient approach – Hydro units in series - pumped storage hydro plants-hydro-scheduling using Dynamic programming and linear programming.

UNIT-IV: AUTOMATIC GENERATION CONTROL: Review of LFC and Economic Dispatch control (EDC) using the three modes of control viz. Flat frequency – tie-line control and tie-line bias control.

UNIT-V: AGC implementation – AGC features - static and dynamic responses of uncontrolled & controlled two-area system.

UNIT-VI: INTERCHANGE OF POWER & ENERGY: Economic interchange between interconnected utilities – Inter utility energy evaluation – Power pools – Transmission effects and Issues: Limitations – Wheeling

UNIT-VII: Power system security-Contingency analysis – linear sensitivity factors – AC power flow methods – contingency selection – concentric relaxation – bounding-security constrained optimal power flow-Interior point algorithm-Bus incremental costs.

UNIT-VIII: Introduction – Maximum likelihood Weighted least squares equation – orthogonal Decomposition estimation method – Algorithm

REFERENCE BOOKS:

1. Allen J.Wood and Wollenberg B.F., 'Power Generation Operation and control', John Wiley & Sons, Second Edition.
2. Nagrath, I.J. and Kothari D.P., 'Modern Power System Analysis', TMH, New Delhi, 1980.
3. D.P.Kothari & J.S.Dhillon, Power System Optimization , PHI,2004

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M.Tech (EPS) II Semester

FLEXIBLE A.C. TRANSMISSION SYSTEMS

UNIT-I: FACTS CONCEPTS: Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

UNIT-II: VOLTAGE SOURCE CONVERTERS: Single phase three phase full wave bridge Converters transformer connections for 12 pulse 24 and 48 pulse operation.

UNIT-III: Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT-IV: STATIC SHUNT COMPENSATION: Objectives of shunt compensation, midpoint voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping.

UNIT-V: Methods of controllable var generation, variable impedance type static var generators switching converter type var generators hybrid var generators.

UNIT-VI: SVC AND STATCOM: The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT-VII: STATIC SERIES COMPENSATORS: concept of series capacitive compensation, improvement of transient stability, power oscillation damping.

UNIT-VIII: Functional requirements, GTO thyristor controlled series capacitors (GSC), thyristor switched series capacitor (TSSC).and thyristor controlled series capacitor (TCSC) control schemes for GSC TSSC and TCSC.

TEXT BOOK:

1. "Understanding FACTS Devices" N. G. Hingorani and L. Guygi. IEEE Press Publications 2000.

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M.Tech (EPS) II Semester

ADVANCED POWER SYSTEM PROTECTION

UNIT-I: STATIC RELAYS: Advantages of static relays- Basic construction of static relays – Level detectors – Replica impedance-mixing circuits-general equation for two input phase and amplitude comparators –Duality between amplitude and phase comparator.

UNIT-II: AMPLITUDE COMPARATORS: Circulating current type and opposed voltage type rectifier bridge comparators –Direct and Instantaneous comparators

Phase comparators: coincidence circuit type block spike phase comparator, techniques to measure the period of coincidence – Integrating type– Rectifier and vector product type phase comparators.

UNIT-III: STATIC OVER CURRENT RELAYS: Introduction-Instantaneous over current relay – Time over current relays-basic principles-Definite time and Inverse definite time over current relays.

UNIT-IV: STATIC DIFFERENTIAL RELAYS: Analysis of static differential relays – static relay schemes –Duo bias transformer differential protection – Harmonic restraint relay.
Static distance Relays: Static impedance –reactance-MHO and angle impedance relay sampling comparator–realization of reactance and MHO relay using a sampling comparator

UNIT-V: MULTI –INPUT COMPARATORS: Conic section characteristics – Three input amplitude comparator – Hybrid comparator – switched distance schemes –Polyphase distance schemes-Phase fault scheme –Three phase scheme – combined and ground fault scheme.

UNIT-VI: POWER SWINGS: Effect of power swings on the performance of Distance relays- Power swing analysis – Principle of out of step tripping and blocking relays – effect of line length and source impedance on distance relays

UNIT-VII: MICROPROCESSOR BASED PROTECTIVE RELAYS-I: Over current relays – impedance relays – directional relay – reactance relay (Block diagram and flow chart approach only).

UNIT-VIII: MICROPROCESSOR BASED PROTECTIVE RELAYS-II: Generalized mathematical expression for distance relays - measurement of resistance and reactance – MHO and offset MHO relays –Realization of MHO characteristics – Realization of offset MHO characteristics (Block diagram and flow chart approach only) Basic principle of Digital computer relaying

REFERENCE BOOKS:

1. T.S.MadhavaRao, "Power system Protection static relay", Tata McGraw Hill Publishing company limited , second edition,1989
2. Badri Ram and D.N.Vishwakarma, " Power system Protection and Switchgear ", Tata McGraw Hill Publication company limited First Edition -1995

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M.Tech (EPS) II Semester

DISTRIBUTED GENERATION

UNIT-I: CENTRALIZED GENERATION: Main features, Economics, Advantages & Disadvantages De-centralized / distributed / Embedded / Dispersed Generation, Operation of Distributed Generation Systems, Consideration of Reliability & Economics Advantages & Disadvantages, Introduction to energy conversion, Principles of renewable energy systems-technical and social implication.

UNIT-II: Photo voltaic power generation, spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for PV systems, applications of super conducting materials in electrical equipment systems.

UNIT-III: Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology.

UNIT-IV: WIND ENERGY CONVERSION: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics.

UNIT-V: Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation. Wave energy conversion: properties of waves and power content, vertex motion of Waves, device applications. Types of ocean thermal energy conversion systems Application of OTEC systems examples,

UNIT-VI: MISCELLANEOUS ENERGY CONVERSION SYSTEMS: coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion, principles of EMF generation, description of fuel cells **,** Environmental effects of energy conversion systems, pollution from coal and preventive measures steam stations and pollution, pollution free energy systems.

UNIT-VII: Co-generation and energy storage, combined cycle co-generation, energy storage. Global energy position and environmental effects: energy units, global energy position..

UNIT-VIII: Types of fuel cells, H_2-O_2 Fuel cells, Application of fuel cells – Batteries, Description of batteries, Battery application for large power.

TEXT BOOKS:

1. "Energy conversion systems" by Rakosh das Begamudre, New age international publishers, New Delhi - 2000.
2. "Renewable Energy Resources" by John Twidell and Tony Weir, 2nd edition, Fspon& Co

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M.Tech (EPS) II Semester

ENERGY AUDITING, CONSERVATION & MANAGEMENT
(Elective-III)

UNIT-I: BASIC PRINCIPLES OF ENERGY AUDIT: Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT-II: ENERGY MANAGEMENT-I: Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting.

UNIT- III: ENERGY MANAGEMENT-II: Energy manger, Qualities and functions, language, Questionnaire - check list for top management

UNIT- IV: ENERGY EFFICIENT MOTORS: Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics - variable speed, variable duty cycle systems, RMS hp-voltage variation-voltage unbalance- over motoring- motor energy audit

UNIT- V: POWER FACTOR IMPROVEMENT, LIGHTING: Power factor – methods of improvement, location of capacitors, Pf with non linear loads, effect of harmonics on p.f., p.f motor controllers - Good lighting system design and practice, lighting control, lighting energy audit.

UNIT- VI: ENERGY INSTRUMENTS: Energy Instruments watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's.

UNIT- VII: ECONOMIC ASPECTS AND ANALYSIS: Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, and life cycle costing analysis - Energy efficient motors.

UNIT-VIII: COMPUTATION OF ECONOMIC ASPECTS: Calculation of simple payback method, net present worth method - Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

REFERENCE BOOKS:

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998.
3. Energy efficient electric motors by John C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995-
4. Energy management hand book by W.C.Turner, john Wiley and sons
5. Energy management and good lighting practice: fuel efficiency- booklet12-EEO.

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M.Tech (EPS) II Semester

MODERN POWER ELECTRONICS
(Elective-III)

UNIT-I: HIGH-POWER SEMICONDUCTOR DEVICES: Introduction, High-Power Switching Devices, Diodes, Silicon-Controlled Rectifier (SCR), Gate Turn-Off (GTO) Thyristor, Gate-Commutated Thyristor (GCT), Insulated Gate Bipolar Transistor (IGBT), Other Switching Devices, Operation of Series-Connected Devices, Main Causes of Voltage Unbalance ,Voltage Equalization for GCTs, Voltage Equalization for IGBTs

UNIT-II: TWO-LEVEL VOLTAGE SOURCE INVERTER: Introduction, Sinusoidal PWM , Modulation Scheme ,Harmonic Content, Overmodulation, Third Harmonic Injection PWM, Space Vector Modulation , Switching States , Space Vectors, Dwell Time Calculation, Modulation Index , Switching Sequence, Spectrum Analysis, Even-Order Harmonic Elimination, Discontinuous Space Vector Modulation.

UNIT-III: CASCADED H-BRIDGE MULTILEVEL INVERTERS: Introduction, H-Bridge Inverter, Bipolar Pulse-Width Modulation, Unipolar Pulse-Width Modulation, Multilevel Inverter Topologies, CHB Inverter with Equal dc Voltage, H-Bridges with Unequal dc Voltages, Carrier Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level-Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted, PWM Schemes , Staircase Modulation.

UNIT-IV:DIODE-CLAMPED MULTILEVEL INVERTERS: Introduction, Three-Level Inverter , Converter Configuration, Switching State ,Commutation, Space Vector Modulation, Stationary Space Vectors , Dwell Time Calculation, Relationship Between *V_ref*Location and Dwell Times, Switching Sequence Design, Inverter Output Waveforms and Harmonic Content , Even-Order Harmonic Elimination, Neutral-Point Voltage Control, Causes of Neutral-Point Voltage Deviation , Effect of Motoring and Regenerative Operation, Feedback Control of Neutral-Point Voltage, Other Space Vector Modulation Algorithms, Discontinuous Space Vector Modulation, SVM Based on Two-Level Algorithm, High-Level Diode-Clamped Inverters, Four- and Five-Level Diode-Clamped Inverters, Carrier-Based PWM.

UNIT-V: DC-DC SWITCH-MODE CONVERTERS: Introduction, control of dc-dc converter, Buck converter, boost converter, buck-boost converter, cuk dc-dc converter, full-bridge dc-dc converter, dc-dc converter comparison.

UNIT-VI: SWITCHING DC POWER SUPPLIES: Introduction, linear power supplies, overview of switching power supplies, dc-dc converters with electrical isolation, control of switch mode dc power supplies, power supply protection, and electrical isolation in the feedback loop, designing to meet the power supply specifications.

UNIT-VII: RESONANT CONVERTERS: Introduction, classification of resonant converters, basic resonant circuit concepts, load-resonant converters, resonant-switch converters, zero-voltage-switching, resonant-dc-link inverters with zero-voltage switching's, high frequency-link integral-half cycle converters.

UNIT-VIII: POWER CONDITIONERS AND UNINTERRUPTIBLE POWER SUPPLIES: Introduction, power line disturbances, Introduction to Power Quality, power Conditioners, uninterruptible power supplies, Applications.

REFERENCE BOOKS:

1. Power electronics circuits, Devices and applications — M.H. Rashid PHI –I edition –1995.
2. "Power Electronics converters, Applications and Design" Ned Mohan, Tore M. Undeland and William P. Robbins, A John Wiley & Sons, Inc., Publication 3rd Edition.
3. "High-Power Converters And Ac Drives" Bin Wu,A John Wiley & Sons, Inc., Publication(Free down load from rapidshire.com)

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M.Tech (EPS) II Semester

POWER SYSTEM DYNAMICS
(ELECTIVE-III)

UNIT-I: BASIC CONCEPTS: Power system stability status of operation and system security, system dynamics problems, system model analysis of steady state stability and transient stability, simplified representation of excitation control

UNIT-II: SYNCHRONOUS MACHINE MODELING: Synchronous Machine modeling – mathematical description of a synchronous machine – The dqo transformation – equivalent circuits for direct and quadrature axes – steady state analysis – electrical transient performance characteristics – equations of motion.

UNIT-III: POWER SYSTEM LOADS: Power system loads – Basic load modeling concepts – modeling of Induction motors – Synchronous motor model – acquisition of load – model parameters.

UNIT- IV: SMALL – SIGNAL STABILITY: Small – Signal Stability – fundamental concepts of stability of dynamic systems – Eigen properties of the state matrix – small signal stability of a single machine infinite bus system – effects of excitation system

UNIT-V: MODELING OF EXCITATION SYSTEMS: Excitation system requirements, Elements of an excitation system, types of excitation systems-Control and protective functions, Excitation System Modeling, Excitation System Block Diagram.

UNIT-VI: TRANSIENT STABILITY ANALYSIS: Transient Stability – an elementary view of transient stability – numerical integration methods – simulation of power system dynamic response – analysis of unbalanced faults – performance of protective relaying – case study of transient stability a large system – direct method transient stability analysis.

UNIT-VII: APPLICATION OF POWER SYSTEM STABILIZER: Basic Concepts in applying PSS, control signals, Structure and Tu8ning of PSS Washout circuit, Dynamic compensator analysis of single machine infinite bus system with and without PSS.

UNIT-VIII: SUB SYNCHRONOUS OSCILLATIONS: Sub synchronous oscillations – turbine generator torsional characteristics – torsional interaction with power system controls – sub synchronous resonance – Impact of network switching disturbances – torsional interaction between closely coupled units – Hydro generator torsional characteristics.

REFERENCE BOOK:

1. **"**Power System Stability and Control" by P.Kundur McGraw-Hill Inc.

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M.Tech (EPS) II Semester

ELECTRIC POWER DISTRIBUTION AND AUTOMATION (ELECTIVE-IV)

UNIT – I: GENERAL CONCEPTS: Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, contribution factor loss factor - Relationship between the load factor and loss factor. Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

UNIT – II: GENERAL ASPECTS OF D.C. DISTRIBUTION SYSTEMS: Classification of Distribution Systems - Comparison of DC vs AC and Under-Ground vs Over - Head Distribution Systems- Requirements and Design features of Distribution Systems-Voltage Drop Calculations (Numerical Problems) in D.C Distributors for the following cases: Radial D.C Distributor fed one end and at the both the ends (equal/unequal Voltages) and Ring Main Distributor.

UNIT III: A.C. DISTRIBUTION SYSTEMS: Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system. Voltage Drop Calculations (Numerical Problems) in A.C. Distributors for the following cases: Power Factors referred to receiving end voltage and with respect to respective load voltages.

UNIT IV: POWER FACTOR, VOLTAGE CONTROL: Causes of low p.f - Methods of Improving p.f -Phase advancing and generation of reactive KVAR using static Capacitors-Most economical p.f. for constant KW load and constant KVA type loads, Numerical Problems. Dependency of Voltage on Reactive Power flow.- Methods of Voltage Control: Shunt Capacitors, Series Capacitors, Synchronous Capacitors, Tap changing and Booster Transformers.

UNIT V: PROTECTION AND COORDINATION OF DISTRIBUTION SYSTEMS: Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Reclosures, line sectionalizes, and circuit breakers Coordination of Protective Devices: General coordination procedure.

UNIT – VI: INTRODUCTION TO AUTOMATION: Introduction: Why distribution automation, power delivery systems, control hierarchy, DA concept, distribution automation system, basic architectures and implementation strategies for DA

UNIT – VII: CENTRAL CONTROL AND MANAGEMENT: Central Control and Management: Why power system control, operation environment of distribution networks, evolution of Distribution management systems, basic distribution management function, basis of a real time control system, outage management, decision support applications, database structures and interfaces.

UNIT – VIII: DISTRIBUTION AUTOMATION AND CONTROL FUNCTIONS: Distribution Automation and Control Functions: Introduction, Demand side management, Voltage/Var control, fault detection, restoration function, reconfiguration of distribution systems, power quality.

TEXT BOOKS

1. "Electric Power Distribution system, Engineering" – by TuranGonen, McGraw-hill Book Company.
2. "Electric Power Distribution "– by A.S. Pabla, Tata McGraw-hill Publishing Company, 4th edition, 1997.
3. "Electric Power Distribution Automation, Protection and Control" –by James A. Momoh, CRC Press, Taylor and Francis, 2008.
4. "Control and Automation of Electric Power Distribution Systems"– by James N-Green and R. Wilson, CRC Press, Taylor andFranscis, 2007.

REFERENCE BOOKS

1. "Electric Power Distribution Automation" by Dr. M. K. Khedkar and Dr. G. M. Dhole, University Science Press.
2. "Electrical Power Distribution Systems" by V. Kamaraju, Right Publishers.
3. "Electrical Power Systems for Industrial Plants" by Kamalesh Das, JAICO Publishing House.
4. "Hand Book of Electric Power Distribution" by G. Ramamurthy, 2nd Edition, Universities Press.

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M.Tech (EPS) II Semester

TRANSIENTS IN POWER SYSTEMS
(ELECTIVE-IV)

UNIT I: TRAVELLING WAVES ON TRANSMISSION LINE: Lumped and Distributed Parameters – Wave Equation – Reflection, Refraction, Behaviour of Travelling waves at the line terminations – Lattice Diagrams – Attenuation and Distortion – Multi-conductor system and Velocity wave.

UNIT II: COMPUTATION OF POWER SYSTEM TRANSIENTS: Principle of digital computation – Matrix method of solution, Modal analysis, Z transforms, Computation using EMTP – Simulation of switches and non-linear elements.

UNIT III: LIGHTNING SURGES: Review of various types of power system transients - effect of transients on power systems - relevance of the study and computation of power system transients - electrification of thunder clouds - lightning current stages - lightning current parameters and their values - stroke to tower and midspan - induced lightning surges.

UNIT IV: SWITCHING SURGES: Closing and reclosing of lines - load rejection - fault initiation - fault clearing - short line faults - ferro resonance - isolator switching surges - temporary over voltages - surges on an integrated systems - switching - harmonics.

UNIT V: IMPULSEVOLTAGES: Generation of high AC and DC-impulse voltages, currents-measurement using sphere gaps-peak voltmeters-potential dividers and CRO.

UNIT VI: BEHAVIOUR OF WINDING UNDER TRANSIENT CONDITION: Initial and Final voltage distribution - Winding oscillation - traveling wave solution - Behaviour of the transformer core under surge condition – Rotating machine – Surge in generator and motor.

UNIT VII: CURRENT CHOPPING PHENOMENON: Current chopping in circuit breakers. Short line fault condition and its relation to circuit breaker duty. Trapped charge effects. Effect of source and source representation in short linefault studies. Control of transients.

UNIT VIII: INSULATION CO-ORDINATION: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS), insulation level, statistical approach, co-ordination between insulation and protection level –overvoltage protective devices – lightning arresters, substation earthing.

REFERENCE BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Willey Interscience, New York, 1971.
2. Klaus Ragaller, 'Surges in High Voltage Networks', Plenum Press, New York, 1980.
3. W. Diesendorf, 'Over Voltage on High Voltage Systems', Renselaer Bookstore, Troy New York, 1971.
4. H.A. Peterson, 'Transient in Power Systems', Dover Publication, New York, 1963.
5. Rakosh das Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Ltd, 1990.
6. C.S. Indulkar and D.P. Kothari, 'Power System Transients' - A Statistical approach, Prentice Hall, 1996.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::RAJAMPET
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M.Tech (EPS) II Semester

RESTRUCTURED POWER SYSTEM
(ELECTIVE-IV)

UNIT I: KEY ISSUES IN ELECTRIC UTILITIES: Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange - Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

UNIT II: OPEN ACCESS SAME-TIME INFORMATION SYSTEM (OASIS) : Structure of OASIS - Posting of Information – Transfer capability on OASIS.

UNIT III: AVAILABLE TRANSFER CAPABILITY (ATC) : Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow.

UNIT IV: ELECTRICITY PRICING: Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

UNIT V: POWER SYSTEM OPERATION IN COMPETITIVE ENVIRONMENT: Introduction – Operational Planning Activities of ISO- The ISO in Pool Markets – The ISO in Bilateral Markets – Operational Planning Activities of a GENCO.

UNIT VI: MARKET POWER: Introduction - Different types of market Power – Mitigation of Market Power - Examples.

UNIT VII: **TRANSMISSION CONGESTION MANAGEMENT:** Introduction - Transmission Cost Allocation Methods : Postage Stamp Rate Method - Contract Path Method - MW-Mile Method – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods.

UNIT VIII: ANCILLARY SERVICES MANAGEMENT: Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.

REFERENCE BOOKS:

1. Operation of Restructured Power System, Kankar Bhattacharya, Math H.J. Boller and JaapE.DaalderKulwer Academic Publishers, 2001.
2. Restructured Electrical Power Systems, Mohammad Shahidehpour and Muwaffaqalomoush, Marcel Dekker, Inc., 2001.
3. Power System Restructuring and Deregulation, Loi Lei Lai, John Wiley & Sons Ltd., England.

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M.Tech (EPS) II Semester

POWER SYSTEM SIMULATION LAB

Any Ten experiments.

1. Performance of transmission line.
    1. Modeling of long transmission line.
    2. Simulation of Compensation Techniques of Transmission Line.
    3. Y_{Bus}&Z_{Bus} formation.
    4. Load flow Studies.
    5. Short Circuit Studies.
    6. Transient Stability Analysis of single machine System.
    7. Transient Stability Analysis of Multi machine System.
    8. Simulation of Single Area and Two Area Systems load frequency control.
    9. Simulation of Steady State and Transient State of a linear power system.
    10. Transfer function model to state variable model and vice versa.
    11. Simulation of Thyristor convertors & IGBT Inverters.
    12. Simulation of Facts Controller.
    13. Economic Load dispatch.
    14. Load forecasting and Unit Commitment.

(Software MATLAB/ Mi-POWER /PSCAD/ETAP/LABVIEW will be used)